DEPARTMENT OF COMMERCE

UNITED STATES BUREAU OF MINES
SCOTT TURNER, DIRECTOR

INFORMATION CIRCULAR

CLAY MINING METHODS AND COSTS AT THE CORUNNA (MICH.) PIT OF THE AETNA PORTLAND CEMENT CO.

RECEIVED
OCT 15

BY

OLIVER A. DIBBLE

Generated on 2024-09-17 12:29 GMT / https://hdl.handle.net/2027/osu.32435030644140
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

Digitized by Google

Original from
THE OHIO STATE UNIVERSITY

I.C.6657,
September, 1932.

INFORMATION CIRCULAR

DEPARTMENT OF COMMERCE - BUREAU OF MINES

CLAY MINING METHODS AND COSTS AT THE CORUNNA (MICH.) PIT OF THE AETNA PORTLAND CEMENT CO.[1]

By Oliver A. Dibble[2]

INTRODUCTION

This paper is one of a series being prepared for and published by the United States Bureau of Mines, describing mining methods and costs at clay pits throughout the United States. These papers are designed to disseminate technical information regarding the methods used. The cost tabulations represent operating expenditures only and not total costs. It is recognized that publication of total costs might in many instances cause embarrassment to individual operators as well as to the industry as a whole. On the other hand, operating costs are essential to the technical discussion and study of the methods employed. The attention of the reader is specifically called to this differentiation in order that no misunderstanding of the scope of the cost tabulations shall ensue.

The open-pit recovery of clay for cement plants is a comparatively simple operation in comparison with underground mining of clays; nevertheless, it represents an appreciable factor in the cost of cement manufacture.

The following report deals specifically with the methods employed by the Aetna Portland Cement Co., which operates cement mills at Fenton and Bay City, Mich., in recovering clay from their pit at Corunna, Mich., on the Grand Trunk Western Railway.

HISTORY

In 1903 the Aetna Portland Cement Co. started its cement mill at Fenton, Mich., and at that time opened the Corunna clay pit. Almost simultaneously the Hecla Portland Cement Co. of Bay City, Mich., and the Egyptian Portland Cement Co. of Fenton started operation, opening other portions of the Corunna clay deposit. The clay rights were purchased from the Corunna Coal Co. on the northwest 40 acres of the tract (see fig. 1) by the Aetna Portland Cement Co. and on the northeast 40 acres by the Egyptian Portland Cement Co.

The early digging of clay was interesting because of its crudeness. The stripping was let on contract to a man with a ½-cubic yard, stiff-arm Vulcan shovel. About half an acre was stripped to a depth of 3 feet in two months. The contract for loading clay was let to a group of teamsters, and the digging was done with slip scrapers; these were drawn to a small trestle and dumped into narrow-gage cars, which had been acquired from the Corunna Coal Co. These cars were then pulled by teams up another trestle where they were dumped into flat cars with 10-inch sides and no end gates. These cars held from 15 to 18 tons. The property was operated in this way during the first summer. The next year, however, the slip scrapers were replaced by the previously mentioned Vulcan shovel. This shovel was so handicapped in its

1 - The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from U. S. Bureau of Mines Information Circular 6657."

2 - One of the consulting engineers, U. S. Bureau of Mines, and general superintendent, Aetna Portland Cement Co.

Generated on 2024-09-17 12:29 GMT / https://hdl.handle.net/2027/osu.32435030644140
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

work because it could not swing, that it was abandoned in the following year, 1905. The procedure then adopted was to use teams with wheel scrapers to dig and haul the clay up a trestle, and to dump the load by hand into railroad cars on the track below. These cars differed from the others only in that they had 24-inch sides. With this plan, 13 wheel-scraper teams and two plow teams could load twelve 30-ton cars daily.

In 1906 the Hecla Portland Cement Co. moved its clay operations to a pit near Bay City, leaving only the Egyptian Portland Cement Co. and Aetna Portland Cement Co. digging at Corunna. These companies continued the slip-scraper plan of digging at a contract price of $0.24 per ton from 1905 to 1916.

In 1916 the Aetna Portland Cement Co. cancelled their digging contracts and purchased a 5/8-yard, full-circle swing, 4-wheel, traction-type shovel fitted with a 12-foot boom. This shovel with the assistance of eight men loaded five 40-ton cars in a 10-hour day. In 1919 the Egyptian Portland Cement Co. bought a 5/8-yard shovel and followed the Aetna plan of digging. In 1923 the Bay City cement mill of the Aetna Portland Cement Co. started operations, which required an increased clay production. About that time the Egyptian Portland Cement Co. purchased a 1-yard full-circle swing, 4-wheel, traction-type shovel fitted with a 20-foot boom and sold the old shovel to the Aetna Portland Cement Co. to care for the extra tonnage required. In 1927 the Egyptian Portland Cement Co. discontinued operations at Fenton and the Aetna Portland Cement Co. bought their 1-yard shovel and all their clay rights. Two years later the Aetna Portland Cement Co. purchased the Rose farm which adjoins its other property on the south (see fig. 1) and in the summer of 1930 started digging from this deposit. In addition to this property the company owns 80 acres containing approximately 2,000,000 cubic yards of high-grade clay near Midland, Mich., on the Pere Marquette Railway. This is to be opened for use at the Bay City Plant in the near future.

PHYSICAL CHARACTERISTICS OF THE DEPOSIT

The Corunna pit comprises approximately 100 acres, of which 80 have been dug over to an average depth of 12 feet. The remaining 20 acres are estimated to contain 380,000 cubic yards of available material, averaging 15 per cent sand.

Those sections of the deposit which were first worked were low in sand. The last deposit (Rose farm), however, contains considerable sand, and consequently the material is more difficult to grind to the required fineness. There is no definite stratification to the clay and on this particular deposit there is practically no overburden. The little overburden is a clayey soil which mixes well with the clay and causes no difficulty. Occasionally pockets of sand and gravel are found in the clay. These are of irregular occurrence and are shovelled to one side as the clay is removed.

SAMPLING

Due to the sand and gravel pockets, accurate sampling of the deposit is difficult and the results are not always representative. If a sand pocket is struck it is bound to contaminate the sample, and it is impossible to determine the area of usable clay without a great many test holes. However, test holes give a fair idea as to the location of available material, and they are put down every 50 feet for each shovel cut. Two men with an auger can sink an average of five holes in 10 hours. The cement-plant laboratories run the samples during spare time. One man can run approximately 20 samples in a 10-hour day.

Sand content is an important factor in clay, due principally to its high resistance to grinding, as fine preliminary grinding is essential to good burning and a fine finishing grind is essential to high quality in Portland cement.

Generated on 2024-09-17 12:30 GMT / https://hdl.handle.net/2027/osu.32435030644140
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

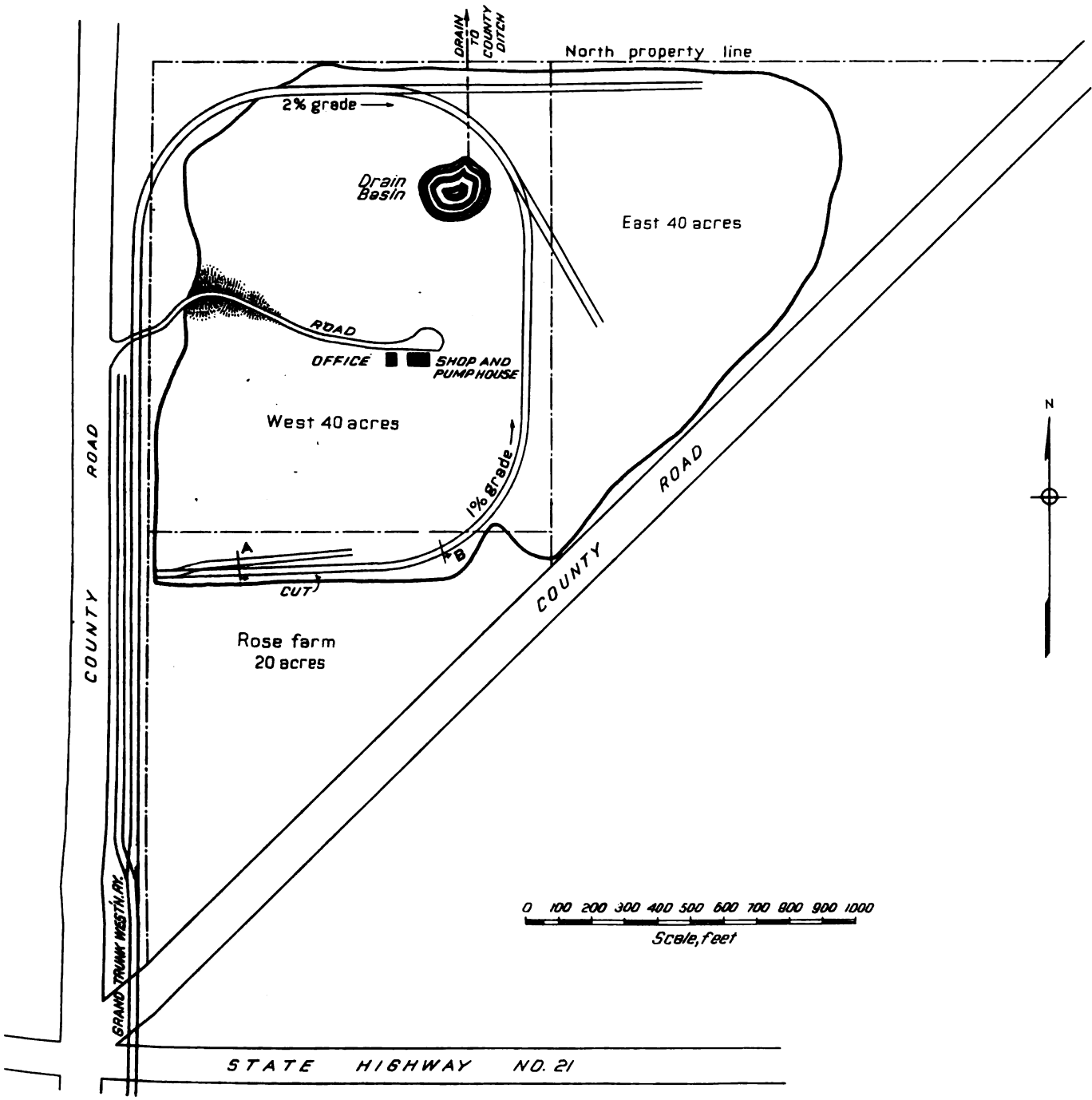

Figure 1.- Property map

Generated on 2024-09-17 12:25 GMT / https://hdl.handle.net/2027/osu.32435030644140
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

The determination of sand in the clay is made from samples taken as follows: The auger is sunk about 6 inches at a time and then pulled, and a small sample is taken from each inch of the auger and placed in a bag. Separate bags are used for the material from each 5 feet of hole; if a definite change in the deposit is observed at any time, a new sample bag is used, and the depth at which the change occurred is noted.

The samples are then sent to the laboratory, dried, ground, and a 100-gram sample is washed through a 100-mesh sieve. The oversize is dried and weighed, the weight being the percentage of sand in the clay.

MINING METHOD

The method of mining is simple. The clay is dug in a single bench by two steam shovels which load directly to the railroad cars. However, in year-around operations there are such problems involved as track moving, drainage, and blasting.

The shovel cuts are approximately 50 feet wide and 10 to 20 feet in vertical depth, averaging about 12 feet. The larger shovel takes a full 50-foot cut, while the small one takes about 40 feet, so that when the two shovels meet either the larger shovel continues and finishes the cut or the small shovel doubles back, depending on the demand for material and the length of the cut. The cut now being made is approximately 500 feet long, and the two shovels load from 450 to 500 tons per day.

When a cut is completed all waste material is thrown over the track out of the way, and a tractor and men move the track into position for the next cut.

The pit is worked 10 hours a day with two shovels and an average crew of eight men. The actual digging does not begin until 8:30 or 9 a.m., as steam has to be raised in the shovel boilers. During this delay the men are employed in track maintenance.

The large shovel with the 1-yard dipper can load a 50-ton car in 25 minutes and the smaller shovel with the 5/8-yard dipper can load a car in one hour. In extremely cold weather it is sometimes necessary to blast to loosen the clay ahead of the shovel. In this case 2-inch holes are drilled and light charges of dynamite are used. However, the blasting done during the year is negligible.

The requirements of the two cement mills do not demand the total capacity of both shovels. The present cut is high in sand at one end and low at the other. The Bay City mill can use the clay with the higher sand content but the Fenton mill can not; hence the two shovels are used to dig the different types of clay for the respective mills. A beneficial change could be made by using a 3/4-yard dipper on the 1-yard shovel. The clay is hard to dig due to its cohesiveness, and the use of an over-powered shovel would materially lengthen its life while not appreciably decreasing production.

TRANSPORTATION

The railroad switch engine places the empties and takes out the loaded cars about 7 a.m. If the cut is short the engine switches the empty cars to the siding on the upper grade of the track which is on the south side of the pit (see A, fig. 1), and as cars are required they are switched out with the shovel winches.

Track moving is necessary about every three months. It delays mining and is a costly operation, especially in wet weather, while in dry weather it means a delay of 1½ days with little extra cost.

When a cut is completed all cars are switched out, all waste is thrown out of the way, and the track is cut in two places, at A and B (see fig. 1). A local farmer and his tractor are hired to assist the regular pit crew. The track is pulled into the new position, and

Generated on 2024-09-17 12:27 GMT / https://hdl.handle.net/2027/osu.32435030644140
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

ties and rails laid to connect it with the unmoved track. In dry weather cinders are then tamped around the ties for ballast, but in wet weather the cinders must be laid first and a larger crew is necessary. Moving and preparing the track for temporary use takes about two days of 10 hours each, and an average of about 100-man-hours is required in addition to, bring the track to standard condition. This additional work is done by the regular operating crew during their spare time.

A continual track maintenance is carried on by the regular crew to the extent of about 10 man-hours per day in addition to supervision. Maintenance, of course, requires more time in wet weather than in dry.

MISCELLANEOUS EQUIPMENT

A team is employed continuously for hauling supplies such as coal, etc. There is a general pipe and forge shop for temporary repairs. A ½-hp., 2-cycle gasoline engine with 3-inch bore and 5-inch stroke drives a 3-cylinder, 8-inch duplex pump which delivers 30 gallons of water per minute to the shovels against a 15-foot vertical head. An interesting fact regarding this engine is that it has given seven years service with a repair cost of only $2.45.

Figure 2 shows the organization of the operating personnel.

The wages paid are as follows:

Wage Scale

	Monthly basis	Hourly basis
1 foreman....	$175.00	-
2 engineers	-	$0.50 and $0.45
2 firemen....	-	.40
3 laborers..	-	.40

Generated on 2024-09-17 12:42 GMT / https://hdl.handle.net/2027/osu.32435030644140
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

TABLE 1.- Clay-Pit Costs

Corunna pit. Period, Feb. 15 to Dec. 15, 1931.

Tonnage excavated 112,500.

	Man-hours	Pay roll	Cost per ton
Labor, operation:			
Supervision	2,300	$1,548.00	$0.0138
Engineer	4,320	1,944.00	.0173
Firemen	4,320	1,728.00	.0153
Pitmen	6,040	2,416.00	.0215
	16,980	7,636.00	0.0679
Labor, track moving:			
Supervision	100	67.30	.0006
Labor	920	379.50	.0034
Tractor and driver	150	150.00	.0013
	1,170	596.80	0.0053
Labor, track maintenance:			
Supervision	200	134.70	.0011
Labor	2,600	1,072.50	.0095
	2,800	1,207.20	0.0106
Labor, total	20,950	9,440.00	.0838
Material:			
Coal, tons	150	637.50	.0057
Repairs (1)	-	1,122.30	.0100
		1,759.80	0.0157

Total costs

	Man-hours	Cost	Cost per ton
Labor:			
Operating	16,980	$7,636.00	$0.0679
Track moving	1,170	596.80	.0053
Track maintenance	2,800	1,207.20	.0106
Material:			
Coal	-	637.50	.0057
Repairs	-	1,122.30	.0100
Team:	-	650.00	.0057
Total	20,950	11,849.80	0.1052

Total man-hours per ton 0.1862

(1) Track, ties, and rails, etc., included in this item.

Generated on 2024-09-17 12:30 GMT / https://hdl.handle.net/2027/osu.32435030644140
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

TABLE 2.- Shovel-Operating Costs

Corunna pit. Period, Feb. 15 to Dec. 15, 1931.

Shovel, Type A 1-cubic yard dipper

Material handled: Overburden 5,000 tons
Clay 68,750 tons

	Clay		Overburden		Total cost per ton clay
	Amount	Cost per ton	Amount	Cost per ton	
Engineers	$502.00	$0.0073	$100.00	$0.020	$0.0088
Firemen	449.00	.0065	90.00	.018	.0078
Pitmen	669.00	.0097	74.00	.015	.0108
Foremen	403.00	.0059	80.00	.016	.0070
Fuel	145.00	.0021	30.00	.006	.0025
Repairs	290.00	.0042	60.00	.012	.0051
Total	2,458.00	0.0357	434.00	0.087	0.0420

Shovel, Type O 5/8-cubic yard dipper

Material handled: Overburden 10,000 tons
Clay 43,750 tons

	Clay		Overburden		Total cost per ton clay
	Amount	Cost per ton	Amount	Cost per ton	
Engineers	$274.00	$0.0063	$ 91.00	$0.0091	$0.0083
Firemen	235.00	.0054	78.00	.0078	.0072
Pitmen	337.50	.0077	112.50	.0112	.0103
Foremen	219.50	.0050	73.50	.0074	.0067
Fuel	94.70	.0022	32.80	.0033	.0029
Repairs	159.00	.0036	53.00	.0053	.0048
Total	1,319.70	0.0302	440.80	0.0441	0.0402

Note: The above tables cover cost during actual digging time only, and do not include maintenance labor.

Generated on 2024-09-17 12:25 GMT / https://hdl.handle.net/2027/osu.32435030644140
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

ORGANIZATION CHART

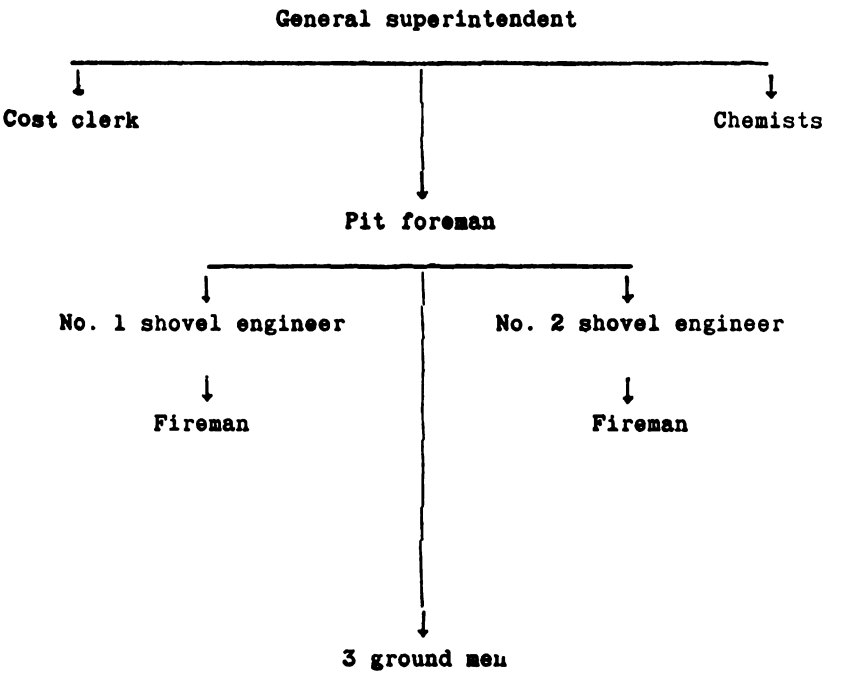

Figure 2.- Organization of operating personnel.

Generated on 2024-09-17 12:23 GMT / https://hdl.handle.net/2027/osu.32435030644140
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY